WHAT IS CLAIMED IS:

1. A bidirectional data and power transmission system for distributing both DC power and data over a plurality of wires, the system comprising:

a power source;

a controller electrically connected to the power source and to the plurality of wires, the controller comprising a current sensor, a controller microprocessor, and a current receiver circuit;

a node electrically connected to the current receiver through the plurality of wires, the node comprising an active current sink, a node microprocessor, and a load; and

wherein the power source supplies a DC voltage.

2. The system of claim 1, wherein the plurality of wires is a pair of wires.

3. The system of claim 1, wherein the controller also comprises a driver comprising a transistor bridge for switching the polarity of the DC voltage on the plurality of wires in response to voltage control signals from the controller microprocessor.

4. The system of claim 3, wherein the driver comprises at least one switch, at least one buffer, and at least one bridge driver for conditioning the voltage control signals from the controller microprocessor.

5. The system of claim 1, wherein the active current sink is controlled using at least one digital output from the node microprocessor.

6. The system of claim 1, wherein the load has a sensor adapted to produce a sensor signal that corresponds to a measurement of a physical state, the sensor signal being adapted for transmission from the node to the controller using the node microprocessor and the active current sink.

7. The system of claim 1, wherein the load comprises an actuator adapted to receive an actuator signal from the controller and to change a physical state associated with the system in response to the actuator signal.

8. The system of claim 1, wherein the power received at the node from the controller is passed through a full-wave rectifier and a passive filter before being supplied to the load.

9. The system of claim 1, wherein the current sensor comprises a low impedance resistor and the current receiver circuit comprises an integrator and a comparator.

10. The system of claim 1, wherein the current sensor comprises a hall sensor and the current receiver circuit comprises an integrator and a comparator.

11. A controller for supplying power and for sending and receiving data from a node in a bidirectional data and power transmission system, the controller comprising:

a controller microprocessor;

a power source adapted to supply a DC voltage;

a plurality of wires electrically connected to the power source and to the node;

a current sensor electrically connected to the power source and to the plurality of wires;

a current receiver circuit comprising an amplifier, an integrator, and a comparator, the current receiver circuit adapted to receive an input signal from the current sensor and to supply an output signal to the controller microprocessor; and

a driver comprising a transistor bridge for switching the polarity of the DC voltage on the plurality of wires in response to voltage control signals from the controller microprocessor.

12. The controller of claim 11, wherein the plurality of wires is a pair of wires.

13. The controller of claim 11, wherein the driver comprises at least one switch, at least one buffer, and at least one bridge driver for conditioning the voltage control signals from the controller microprocessor.

14. The controller of claim 11, wherein the current sensor comprises a low impedance resistor and the current receiver circuit is connected in parallel across the current sensor.

15. The controller of claim 11, wherein the current sensor comprises a hall sensor and the current receiver circuit is connected to the outputs of the hall sensor.

16. A node for receiving power and for sending and receiving data from a controller in a bidirectional data and power transmission system, the node comprising:

a node microprocessor;

a plurality of wires electrically connected to the controller;

a load selected from the group consisting of a sensor and an actuator;

a power conditioning circuit comprising a full-wave rectifier and a passive filter for receiving power in from the plurality of wires and supplying power out to the load;

a data conditioning circuit comprising a detector for receiving data in from the controller on the plurality of wires and supplying data out to the microprocessor; and

an active current sink controlled by at least one digital output from the node microprocessor.

17. The node of claim 16, wherein the plurality of wires is a pair of wires.

18. The node of claim 16, wherein the load is a sensor adapted to produce a sensor signal that corresponds to a measurement of a physical state, the sensor signal being adapted for transmission from the node to the controller using the node microprocessor and the active current sink.

19. The node of claim 16, wherein the load is an actuator adapted to receive an actuator signal from the controller and to change a physical state associated with the system in response to the actuator signal.

20. A bidirectional data and power transmission system for distributing both DC power and data over a plurality of wires, the system comprising:

a power source adapted to supply a DC voltage;

a controller electrically connected to the power source and to the plurality of wires, the controller comprising a current sensor, a controller microprocessor, a current receiver circuit, and a driver comprising a transistor bridge capable of switching the polarity of the DC voltage on the plurality of wires in response

to voltage control signals from the controller microprocessor; and

a node electrically connected to the controller through the plurality of wires, the node comprising an active current sink, a node microprocessor, and a load.

21. The system of claim 20, wherein the plurality of wires is a pair of wires.

22. The system of claim 20, wherein the driver also comprises at least one switch, at least one buffer, and at least one bridge driver for conditioning the voltage control signals from the controller microprocessor.

23. The system of claim 20, wherein the active current sink is controlled using at least one digital output from the node microprocessor.

24. The system of claim 20, wherein the load comprises a sensor adapted to produce a sensor signal that corresponds to a measurement of a physical state, and wherein the sensor signal is transmitted from the node to the controller using the node microprocessor and the active current sink.

25. The system of claim 20, wherein the load comprises an actuator adapted to receive an actuator signal from the node and to change a physical state associated with the system in response to the actuator signal.

26. The system of claim 20, wherein the power received at the node from the controller is passed through a full-wave rectifier and a passive filter before being supplied to the load.

27. The system of claim 20, wherein the current sensor comprises a low impedance resistor and the current receiver circuit comprises an integrator and a comparator.

28. The system of claim 20, wherein the current sensor comprises a hall sensor and the current receiver circuit comprises an integrator and a comparator.

29. A controller for supplying power and for sending and receiving data from a node in a bidirectional data and power transmission system, the controller comprising:

a controller microprocessor;

a power source adapted to supply a DC voltage;

a plurality of wires electrically connected to the power source and to the node;

a current sensor electrically connected to the power source and to the plurality of wires;

a current receiver circuit comprising an amplifier, an integrator, and a comparator, the current receiver circuit adapted to receive an input signal from the current sensor and to supply an output signal to the microprocessor; and

a driver comprising a transistor bridge for switching the polarity of the DC voltage on the plurality of wires in response to voltage control signals from the controller microprocessor, the voltage control signals being conditioned for supply to the transistor bridge by at least one switch, at least one buffer, and at least one bridge driver.

30. The controller of claim 29, wherein the plurality of wires is a pair of wires.

31. The controller of claim 29, wherein the current sensor comprises a low impedance resistor and the current receiver circuit is connected in parallel across the current sensor.

32. The controller of claim 29, wherein the current sensor comprises a hall sensor and the current receiver circuit is connected to the hall sensor.

33. A bidirectional data and power transmission system for distributing both DC power and data over a plurality of wires, the system comprising:

a means for supplying a DC voltage;

a means for receiving a current signal and supplying the current signal to a controller microprocessor, the means for receiving a current signal being electrically connected to the means for supplying a DC voltage; and

a means for detecting a change in DC voltage polarity and for receiving power from the DC voltage, the means for detecting being electrically connected to the means for receiving and the means for supplying.

34. The system of claim 33, wherein the plurality of wires is a pair of wires.

35. The system of claim 33, wherein the means for receiving comprises a means for switching the polarity of the DC voltage on the plurality of wires in response to a voltage control signal from the controller microprocessor.

36. The system of claim 33, wherein the means for detecting comprises a means for producing a sensor signal that corresponds to a measurement of a physical state, and wherein the sensor signal is transmitted from the means for detecting to the means for receiving.

37. The system of claim 33, wherein the means for detecting comprises a means for changing a physical state associated with the system in response to the change in DC voltage polarity.

38. A method of transmitting power and bidirectional data through a plurality of wires, the method comprising steps of:

transmitting a DC voltage with a polarity to a node for use in powering a load connected to the node;

switching the polarity of the DC voltage in accordance with a control signal to the node; and

actively sinking current at the node in order to send a response signal.

39. The method of claim 38, further comprising the steps of:

generating the control signal using at least one controller output line; and

generating the response signal using a node output line.

40. The method of claim 38, wherein, in the step of switching, the switching is accomplished through a driver comprising a transistor bridge.

41. The method of claim 38, wherein, in the step of actively sinking, the sinking is accomplished through an active current sink comprising a network of transistors and resistors.

42. The method of claim 38, further comprising the steps of:

rectifying the DC voltage received at the node, and

filtering the DC voltage received at the node.

43. The method of claim 38 wherein the plurality of wires is a pair of wires.

44. A method for driving a transistor bridge, the method comprising the steps of:

switching a first transistor in the transistor bridge off;

switching a second transistor in the transistor bridge on after the first transistor is turned off; and

balancing a first input capacitance of the first transistor with a second input capacitance of the second transistor.

45. A circuit block adapted to prevent shorting of a power source across a transistor bridge including a first transistor and a second transistor, comprising:

a resistor adapted to prevent currents from flowing and increase a time constant for turning on the second transistor; and

a capacitor of capacitance approximately equal to the difference in input capacitance between the first transistor and the second transistor.